EARTH-LIFE
SCIENCE
INSTITUTE

Kepa Ruiz-Mirazo

Prebiotic systems evolution as a process of protocell development

1
00:00:00,160 --> 00:00:15,010
[Music]

2
00:00:21,769 --> 00:00:18,439
so thanks thanks for the invitation to

3
00:00:23,359 --> 00:00:21,779
come here the organization was very

4
00:00:27,320 --> 00:00:23,369
efficient organization it's a pleasure

5
00:00:29,950 --> 00:00:27,330
to be here in in Japan again beautiful

6
00:00:33,979 --> 00:00:29,960
country and I was enjoying previous days

7
00:00:37,700 --> 00:00:33,989
now I need to kind of concentrate and

8
00:00:39,770 --> 00:00:37,710
try to give you my my view on on

9
00:00:42,740 --> 00:00:39,780
something that is very big which is the

10
00:00:46,100 --> 00:00:42,750
emergence of a bias receptor it's a huge

11
00:00:49,190 --> 00:00:46,110
word for me but I'm gonna agree with

12
00:00:51,020 --> 00:00:49,200
what Eric said in the morning and part

13
00:00:52,910 --> 00:00:51,030

of it at least i think i'm going to

14
00:00:56,510 --> 00:00:52,920
concentrate more on what I think that

15
00:01:00,760 --> 00:00:56,520
the main players in in this game and

16
00:01:04,100 --> 00:01:00,770
emergence of a biosphere which are cells

17
00:01:06,230 --> 00:01:04,110
microorganisms okay and how we could

18
00:01:08,060 --> 00:01:06,240
work what kind of models do we have of

19
00:01:13,420 --> 00:01:08,070
the emergence of these of these types of

20
00:01:16,179 --> 00:01:13,430
systems there are very complex molecular

21
00:01:20,630 --> 00:01:16,189
machines molecular their factories of

22
00:01:22,580 --> 00:01:20,640
molecules okay in a and they is not just

23
00:01:25,550 --> 00:01:22,590
a question of having molecules together

24
00:01:27,469 --> 00:01:25,560
and it's a question of you know the

25
00:01:29,149 --> 00:01:27,479
spatial organization they heterogeneity

26
00:01:31,190 --> 00:01:29,159
that you have there okay so it's not

27
00:01:33,859 --> 00:01:31,200
it's not it's more complex we just have

28
00:01:39,730 --> 00:01:33,869
having a bag of of molecules like we can

29
00:01:41,870 --> 00:01:39,740
see here in these metabolic pathways but

30
00:01:44,990 --> 00:01:41,880
this metal is emits a vectorial

31
00:01:47,440 --> 00:01:45,000
metabolism this is one of my my my

32
00:01:50,389 --> 00:01:47,450
messages today that when we talk about

33
00:01:55,219 --> 00:01:50,399
the game of life the game that those

34
00:01:57,230 --> 00:01:55,229
players play okay and carrying out the

35
00:01:58,880 --> 00:01:57,240
metabolism metabolism takes place in

36
00:02:01,550 --> 00:01:58,890
heterogeneous conditions in where

37
00:02:05,450 --> 00:02:01,560
different phases are involved not just

38
00:02:08,600 --> 00:02:05,460

water solution okay and so there are

39
00:02:10,460 --> 00:02:08,610
some areas in cell that can be treated

40
00:02:12,890 --> 00:02:10,470
as a pool but some other areas in which

41
00:02:13,900 --> 00:02:12,900
the crowding is so big that you have to

42
00:02:16,270 --> 00:02:13,910
treat them

43
00:02:19,030 --> 00:02:16,280
and also you have of course membranes

44
00:02:21,490 --> 00:02:19,040
and I'm going to most of the of the talk

45
00:02:23,590 --> 00:02:21,500
I'm going to be focusing on how you know

46
00:02:27,990 --> 00:02:23,600
you have to start with chemistry's that

47
00:02:33,310 --> 00:02:30,490
it's like transport processes that

48
00:02:35,050 --> 00:02:33,320
involve different phases not just water

49
00:02:38,500 --> 00:02:35,060
solution okay so that's going to be one

50
00:02:40,780 --> 00:02:38,510
of my so when we we go from this

51
00:02:43,300 --> 00:02:40,790
complexity that we see in in living

52
00:02:46,330 --> 00:02:43,310
organisms in microorganisms and we try

53
00:02:47,740 --> 00:02:46,340
to go down either ships from point of

54
00:02:49,930 --> 00:02:47,750
view of the physiology that could be a

55
00:02:52,810 --> 00:02:49,940
minimal cell we have some news this year

56
00:02:55,960 --> 00:02:52,820
about how could a minimal cell look like

57
00:03:00,220 --> 00:02:55,970
although we haven't learned enough about

58
00:03:02,800 --> 00:03:00,230
what one-third of those genes actually

59
00:03:06,160 --> 00:03:02,810
code for and there is a lot of work to

60
00:03:07,930 --> 00:03:06,170
be done from here to understand the

61
00:03:10,660 --> 00:03:07,940
functions of a lot of the components

62
00:03:13,600 --> 00:03:10,670
here but we are making progress in the

63
00:03:16,420 --> 00:03:13,610

you know top-down approaches and also

64
00:03:19,960 --> 00:03:16,430
when we do phylogenies and compiled if I

65
00:03:22,120 --> 00:03:19,970
lodging is trying to see what kind of

66
00:03:24,910 --> 00:03:22,130
good what kind of the route of treat the

67
00:03:27,820 --> 00:03:24,920
root of that tree of life that we know

68
00:03:30,580 --> 00:03:27,830
that the result of the evolutionary

69
00:03:33,790 --> 00:03:30,590
process that took place on the earth

70
00:03:35,770 --> 00:03:33,800
okay we see that there are different

71
00:03:41,740 --> 00:03:35,780
features and this is one of the

72
00:03:45,040 --> 00:03:41,750
fundamental say advances from molecular

73
00:03:48,940 --> 00:03:45,050
biology last century okay to see that is

74
00:03:52,390 --> 00:03:48,950
so much in common in all types of living

75
00:03:54,820 --> 00:03:52,400
organisms and different people have

76
00:03:57,100 --> 00:03:54,830
focused of different features that make

77
00:03:58,900 --> 00:03:57,110
us all these features and make us be

78
00:04:01,630 --> 00:03:58,910
sure that there was a common origin for

79
00:04:04,890 --> 00:04:01,640
all living beings that we inhabit the

80
00:04:08,199 --> 00:04:04,900
earth today okay and traditionally

81
00:04:11,729 --> 00:04:08,209
probably because of the influence of

82
00:04:14,110 --> 00:04:11,739
molecular biology the question was

83
00:04:16,870 --> 00:04:14,120
articulated in this way with people

84
00:04:19,210 --> 00:04:16,880
we're focusing on on the biopolymer the

85
00:04:21,940 --> 00:04:19,220
critical biopolymers and these are DNA

86
00:04:24,580 --> 00:04:21,950
proteins and when ribozymes were found

87
00:04:26,800 --> 00:04:24,590
we thought that we had a

88
00:04:30,970 --> 00:04:26,810

literally an answer for the urging and

89
00:04:33,460 --> 00:04:30,980
it was RNA okay but the focus was

90
00:04:36,490 --> 00:04:33,470
probably too much on biopolymers okay

91
00:04:41,710 --> 00:04:36,500
and trying to get chemical shortcuts to

92
00:04:44,200 --> 00:04:41,720
biopolymers okay and hoping that natural

93
00:04:47,469 --> 00:04:44,210
selection would do the job once you get

94
00:04:50,620 --> 00:04:47,479
to an RNA world or prerna world okay so

95
00:04:55,420 --> 00:04:50,630
I'm very critical I mean I think the RNA

96
00:04:58,120 --> 00:04:55,430
had a role to play at some point but I'm

97
00:05:00,850 --> 00:04:58,130
rather critical with the traditional way

98
00:05:03,790 --> 00:05:00,860
of conceiving the RNA world just as RNA

99
00:05:05,500 --> 00:05:03,800
molecules population of RNA molecules so

100
00:05:07,300 --> 00:05:05,510
even if we get self-replicating

101
00:05:11,730 --> 00:05:07,310
molecules imagine that you know I don't

102
00:05:14,290 --> 00:05:11,740
know Jerry Joyce manages is some someday

103
00:05:15,490 --> 00:05:14,300
we have the problem of origins of RNA

104
00:05:18,129 --> 00:05:15,500
what does it come from what kind of

105
00:05:20,520 --> 00:05:18,139
scenario what kind of organization what

106
00:05:23,740 --> 00:05:20,530
kind of system that it comes from and

107
00:05:26,890 --> 00:05:23,750
also is if we manage the synthesis

108
00:05:31,270 --> 00:05:26,900
imagine that joan sutherland goes

109
00:05:33,370 --> 00:05:31,280
forward and and you can actually solve

110
00:05:35,920 --> 00:05:33,380
the problem of the origin of RNA and you

111
00:05:39,070 --> 00:05:35,930
have RNA population where do RNA

112
00:05:41,710 --> 00:05:39,080
molecules and natural selection lead you

113
00:05:45,120 --> 00:05:41,720

to okay and this is a big assumption

114
00:05:48,490 --> 00:05:45,130
that they will lead you to a to excel

115
00:05:49,930 --> 00:05:48,500
metallizing cell okay but if you get

116
00:05:53,790 --> 00:05:49,940
already there why do you need a

117
00:05:56,710 --> 00:05:53,800
metabolite in cell to begin with right

118
00:05:58,089 --> 00:05:56,720
so I think that there are many many

119
00:06:00,100 --> 00:05:58,099
problems with these assumptions about

120
00:06:03,029 --> 00:06:00,110
the LNA world and i am trying I'm trying

121
00:06:07,150 --> 00:06:03,039
to come up with a completely different

122
00:06:10,870 --> 00:06:07,160
approach the problem of origin okay and

123
00:06:13,629 --> 00:06:10,880
this is based on a different conception

124
00:06:16,659 --> 00:06:13,639
of the living okay instead of going for

125
00:06:20,680 --> 00:06:16,669
the molecules of life the biopolymers

126
00:06:22,890 --> 00:06:20,690
and trying to get chemical synthetic

127
00:06:25,719 --> 00:06:22,900
shortcuts shortcuts to those molecules

128
00:06:28,360 --> 00:06:25,729
and I think about life in a more kind of

129
00:06:31,150 --> 00:06:28,370
systemic way okay systems approach and

130
00:06:32,770 --> 00:06:31,160
that's that comes from a from a

131
00:06:35,050 --> 00:06:32,780
definition that I'm gonna I'm not going

132
00:06:37,820 --> 00:06:35,060
to fight for today if you want we can

133
00:06:42,620 --> 00:06:37,830
discuss it in the

134
00:06:44,900 --> 00:06:42,630
the questions time but the most

135
00:06:46,670 --> 00:06:44,910
important thing about this is life is

136
00:06:49,820 --> 00:06:46,680
that we conceive of life as a systems

137
00:06:52,550 --> 00:06:49,830
property therefore it's a combination we

138
00:06:55,280 --> 00:06:52,560

shouldn't focus on any each of these

139
00:06:57,080 --> 00:06:55,290
molecules right it's an organization is

140
00:06:59,720 --> 00:06:57,090
a complex organization and we should

141
00:07:02,660 --> 00:06:59,730
also also take into account this dynamic

142
00:07:05,300 --> 00:07:02,670
and complex organization when we

143
00:07:08,150 --> 00:07:05,310
simplify things in the origins of light

144
00:07:11,600 --> 00:07:08,160
models okay that's it that's the basic

145
00:07:16,010 --> 00:07:11,610
so these type of scheme I'm presenting

146
00:07:19,520 --> 00:07:16,020
here is changing I think there's a lot

147
00:07:23,200 --> 00:07:19,530
of proto cellular kind of modeling these

148
00:07:26,480 --> 00:07:23,210
days both empirical and and

149
00:07:28,550 --> 00:07:26,490
computational and we are becoming more

150
00:07:30,620 --> 00:07:28,560
and more aware probably that you know if

151
00:07:34,630 --> 00:07:30,630
you take a different type of conception

152
00:07:37,070 --> 00:07:34,640
of life you probably need to put

153
00:07:39,860 --> 00:07:37,080
metabolism and compartmentalization that

154
00:07:41,420 --> 00:07:39,870
was thought about as later Lake commerce

155
00:07:45,070 --> 00:07:41,430
in the origins of life you have to put

156
00:07:50,060 --> 00:07:45,080
push them towards earlier and earlier

157
00:07:51,950 --> 00:07:50,070
stages okay so regardless of what Jack

158
00:07:56,630 --> 00:07:51,960
szostak says don't pay attention to that

159
00:07:58,970 --> 00:07:56,640
paper your conception of life this is

160
00:08:02,600 --> 00:07:58,980
the first home message for for younger

161
00:08:05,210 --> 00:08:02,610
maybe researchers your conception of

162
00:08:08,030 --> 00:08:05,220
life plays a fundamental role when

163
00:08:09,950 --> 00:08:08,040

designing your research line you can

164
00:08:12,560 --> 00:08:09,960
keep it hidden or you can make it

165
00:08:15,080 --> 00:08:12,570
explicit if you make the effort of

166
00:08:19,330 --> 00:08:15,090
coming out with it with a let's say a

167
00:08:22,030 --> 00:08:19,340
definition as please definition but

168
00:08:24,530 --> 00:08:22,040
that's the way it is in fact I I

169
00:08:27,110 --> 00:08:24,540
exchanged some emails with the five

170
00:08:28,820 --> 00:08:27,120
years ago with with Jack about this and

171
00:08:32,390 --> 00:08:28,830
he told me that he wrote via the paper

172
00:08:35,440 --> 00:08:32,400
be denied in anger so I think the let's

173
00:08:38,000 --> 00:08:35,450
say this is absolutely clear that if

174
00:08:39,620 --> 00:08:38,010
depending on how you conceive of the

175
00:08:41,240 --> 00:08:39,630
leading phenomenon you're going to do

176
00:08:44,000 --> 00:08:41,250
some things in the lab or some others

177
00:08:45,590 --> 00:08:44,010
okay he wanted to a stress that you need

178
00:08:48,140 --> 00:08:45,600
to do things in the lab you to do the

179
00:08:49,400 --> 00:08:48,150
experiments okay but then you should

180
00:08:51,860 --> 00:08:49,410
also

181
00:08:53,720 --> 00:08:51,870
having your head at least a clear

182
00:08:56,269 --> 00:08:53,730
definitely or at least make yourself

183
00:08:58,369 --> 00:08:56,279
let's say pier with what what is your

184
00:09:03,040 --> 00:08:58,379
conception and make it clear also for

185
00:09:05,509 --> 00:09:03,050
the other researchers because it's a so

186
00:09:08,360 --> 00:09:05,519
for example this is a very different

187
00:09:12,980 --> 00:09:08,370
type of way of conceiving life grantees

188
00:09:15,980 --> 00:09:12,990

okay which you have a more complex type

189
00:09:19,610 --> 00:09:15,990
of setting more dynamic let's just okay

190
00:09:24,199 --> 00:09:19,620
so when we make models of origins of

191
00:09:26,509 --> 00:09:24,209
life okay we are all owned the advantage

192
00:09:28,550 --> 00:09:26,519
of us working origins of life is only we

193
00:09:30,939 --> 00:09:28,560
can simplify but we have to be very

194
00:09:34,400 --> 00:09:30,949
careful in the way we simplify okay

195
00:09:36,319 --> 00:09:34,410
maybe going to one type of molecule was

196
00:09:39,920 --> 00:09:36,329
not the right strategy okay we need to

197
00:09:44,119 --> 00:09:39,930
go to a diversity of molecules okay to

198
00:09:46,999 --> 00:09:44,129
begin with okay so this is the core idea

199
00:09:49,129 --> 00:09:47,009
of a new perspective on origins of life

200
00:09:51,949 --> 00:09:49,139
which is the system's chemistry

201
00:09:54,009 --> 00:09:51,959
perspective I think that Martha I don't

202
00:09:58,730 --> 00:09:54,019
know about that but she will speak more

203
00:10:00,590 --> 00:09:58,740
okay your mother okay she will speak

204
00:10:03,530 --> 00:10:00,600
more about this and Sebring probably

205
00:10:06,410 --> 00:10:03,540
tomorrow as well but I don't I would

206
00:10:12,350 --> 00:10:06,420
like to just touch upon a couple of you

207
00:10:13,939 --> 00:10:12,360
say research results of the research

208
00:10:18,280 --> 00:10:13,949
labs that are going in this direction

209
00:10:21,559 --> 00:10:18,290
the first one is Joan Sutherland and

210
00:10:23,689 --> 00:10:21,569
he's finding that hydrogen chemistry

211
00:10:26,120 --> 00:10:23,699
could be a common chemistry for the

212
00:10:30,319 --> 00:10:26,130
formation of a lot of precursor will

213
00:10:34,220 --> 00:10:30,329

precursor molecules and that you know

214
00:10:38,059 --> 00:10:34,230
give you a suit of initial compounds

215
00:10:42,559 --> 00:10:38,069
that could be underlying those initial

216
00:10:45,259 --> 00:10:42,569
stages okay of course if he just does

217
00:10:47,749 --> 00:10:45,269
the synthesis of it and he couples it

218
00:10:49,400 --> 00:10:47,759
with with geochemistry and to some

219
00:10:51,230 --> 00:10:49,410
extent and there are a lot of criticisms

220
00:10:52,939 --> 00:10:51,240
that you can make it but i think this

221
00:10:57,410 --> 00:10:52,949
type of work is very interesting we can

222
00:10:59,629 --> 00:10:57,420
maybe discuss it longer later okay the

223
00:11:02,460 --> 00:10:59,639
other group that i would like to

224
00:11:05,619 --> 00:11:02,470
highlight the spouses group who is

225
00:11:08,679 --> 00:11:05,629
showing that in principle you can run

226
00:11:13,829 --> 00:11:08,689
metabolisms without enzymes okay present

227
00:11:20,019 --> 00:11:13,839
okay in our key and type of conditions

228
00:11:21,849 --> 00:11:20,029
more recently we at last have a model

229
00:11:25,599 --> 00:11:21,859
system that is not the blue so salty

230
00:11:27,460 --> 00:11:25,609
skin reaction we have chemical

231
00:11:31,479 --> 00:11:27,470
complexity of relations and this kind of

232
00:11:33,699 --> 00:11:31,489
things working with organic compounds

233
00:11:37,479 --> 00:11:33,709
that are relevant for origins or

234
00:11:39,849 --> 00:11:37,489
metabolism okay like amides or tiles and

235
00:11:42,549 --> 00:11:39,859
these kind of things okay but the

236
00:11:44,439 --> 00:11:42,559
problem here is that you you work on the

237
00:11:47,139 --> 00:11:44,449
system and you try to find parameter

238
00:11:49,839 --> 00:11:47,149

space where you get this type of complex

239
00:11:52,419 --> 00:11:49,849
behavior without really an autonomous

240
00:11:54,819 --> 00:11:52,429
control on boundary conditions okay so

241
00:11:57,699 --> 00:11:54,829
this is its kind of setting here that

242
00:12:00,789 --> 00:11:57,709
you have here right is pushing the

243
00:12:03,669 --> 00:12:00,799
system with some syringes and to towards

244
00:12:06,009 --> 00:12:03,679
that area of parameter space where you

245
00:12:09,699 --> 00:12:06,019
get this complex interesting behavior

246
00:12:13,299 --> 00:12:09,709
okay the idea here and life on Earth

247
00:12:15,460 --> 00:12:13,309
shows us that there is a lot of

248
00:12:18,099 --> 00:12:15,470
self-organization in a living processes

249
00:12:19,899 --> 00:12:18,109
but the way that self organize those

250
00:12:22,539 --> 00:12:19,909
self-organization processes are control

251
00:12:25,299 --> 00:12:22,549
if it's an autonomous way okay so how

252
00:12:28,829 --> 00:12:25,309
does this begin okay so i think that the

253
00:12:32,499 --> 00:12:28,839
beginning of it seeing the role that

254
00:12:34,569 --> 00:12:32,509
membranes have in or in biological

255
00:12:36,719 --> 00:12:34,579
systems of course biomembranes a very

256
00:12:42,609 --> 00:12:36,729
complex type of boundary condition right

257
00:12:45,969 --> 00:12:42,619
but you could have relatively which is a

258
00:12:48,279 --> 00:12:45,979
much easier type of system that you can

259
00:12:53,469 --> 00:12:48,289
get just in water okay you have a

260
00:12:56,409 --> 00:12:53,479
vesicle here and I the idea of the the

261
00:12:59,109 --> 00:12:56,419
idea that I'm gonna try to put forward

262
00:13:00,759 --> 00:12:59,119
today is that we have to envision the

263
00:13:03,960 --> 00:13:00,769

whole process of origins of life as a

264
00:13:06,639 --> 00:13:03,970
plus the process of coevolution between

265
00:13:10,210 --> 00:13:06,649
reaction dynamics chemistry kinetics

266
00:13:12,369 --> 00:13:10,220
okay and all the types of processes that

267
00:13:14,760 --> 00:13:12,379
have to do with spatial control and and

268
00:13:18,940 --> 00:13:14,770
different types of faces okay

269
00:13:23,350 --> 00:13:18,950
and this very colloidal type of

270
00:13:25,540 --> 00:13:23,360
chemistry and MSC chemistry okay like so

271
00:13:29,080 --> 00:13:25,550
this is a type of a scenario that I'm

272
00:13:31,740 --> 00:13:29,090
going to so this is just all it acid in

273
00:13:36,310 --> 00:13:31,750
water okay you get these beautiful

274
00:13:40,000 --> 00:13:36,320
vesicles ok so we combine in

275
00:13:42,880 --> 00:13:40,010
self-assembly self-assembly right with

276
00:13:46,330 --> 00:13:42,890
complex chemistry see what Epstein and

277
00:13:47,950 --> 00:13:46,340
these people did you know and I could I

278
00:13:49,540 --> 00:13:47,960
mentioned here everything but it could

279
00:13:53,560 --> 00:13:49,550
go all the way down to cheering and you

280
00:13:58,170 --> 00:13:53,570
can see the potential of combining

281
00:14:01,330 --> 00:13:58,180
chemistry reactions with spatial

282
00:14:03,700 --> 00:14:01,340
movement with diffusion in particularly

283
00:14:05,500 --> 00:14:03,710
if you put constraints on diffusion and

284
00:14:07,720 --> 00:14:05,510
you control the diffusion rates of the

285
00:14:12,100 --> 00:14:07,730
system I think that there is a lot you

286
00:14:14,680 --> 00:14:12,110
can gain from it okay so this is the

287
00:14:16,480 --> 00:14:14,690
type of environment the type of context

288
00:14:18,010 --> 00:14:16,490

okay what I think functional

289
00:14:20,680 --> 00:14:18,020
relationships should start building up

290
00:14:25,590 --> 00:14:20,690
okay and this is in fact where natural

291
00:14:30,570 --> 00:14:25,600
selection could actually have let's say

292
00:14:33,100 --> 00:14:30,580
more of operational power to actually

293
00:14:35,890 --> 00:14:33,110
because you need a phenotypic phenotypic

294
00:14:37,150 --> 00:14:35,900
space that is wide enough okay for

295
00:14:39,910 --> 00:14:37,160
natural selection you operate if you

296
00:14:43,360 --> 00:14:39,920
just operating with molecules phenotypic

297
00:14:45,220 --> 00:14:43,370
space is very very limited okay and you

298
00:14:47,800 --> 00:14:45,230
probably will run into many many

299
00:14:53,400 --> 00:14:47,810
bottlenecks but if you start from a

300
00:14:55,480 --> 00:14:53,410
scenario where you have you know wider

301
00:14:57,460 --> 00:14:55,490
possibilities in terms of molecules

302
00:14:59,140 --> 00:14:57,470
playing different types of functions in

303
00:15:01,000 --> 00:14:59,150
this type of system I think that that's

304
00:15:02,940 --> 00:15:01,010
where natural selection is going to be

305
00:15:07,050 --> 00:15:02,950
working ok so it's very important to

306
00:15:09,490 --> 00:15:07,060
start with with precursors okay and

307
00:15:12,370 --> 00:15:09,500
talking about precursors and the

308
00:15:15,520 --> 00:15:12,380
probiotic possibility of those

309
00:15:17,710 --> 00:15:15,530
precursors i'm going to show you the

310
00:15:23,110 --> 00:15:17,720
type of work that we're doing now with

311
00:15:27,370 --> 00:15:23,120
what i think is that the most generally

312
00:15:37,850 --> 00:15:34,639
molecules that have a wider support in

313
00:15:42,019 --> 00:15:37,860

terms of probiotic possibility of those

314
00:15:45,400 --> 00:15:42,029
and then some Alfie files okay and amino

315
00:15:50,920 --> 00:15:45,410
acids okay so we start with really very

316
00:15:53,389 --> 00:15:50,930
basic molecular building blocks okay and

317
00:15:57,560 --> 00:15:53,399
the one piece of work that i'm going to

318
00:15:59,810 --> 00:15:57,570
show you from our lab in that we must

319
00:16:02,600 --> 00:15:59,820
published last year okay has to do with

320
00:16:06,250 --> 00:16:02,610
this you have an amino acid okay and if

321
00:16:09,980 --> 00:16:06,260
feasible if you do the reaction in you

322
00:16:11,960 --> 00:16:09,990
activate the amino acid okay and you

323
00:16:14,870 --> 00:16:11,970
create a log stress alone for example

324
00:16:16,759 --> 00:16:14,880
okay and you have this reaction that was

325
00:16:20,389 --> 00:16:16,769
very well characterized by a robber

326
00:16:23,389 --> 00:16:20,399
Pascal and his team in montpelier okay

327
00:16:25,009 --> 00:16:23,399
in which you had you are another amino

328
00:16:28,460 --> 00:16:25,019
acid then you have the D peptide and

329
00:16:30,889 --> 00:16:28,470
they were trying to see what was the if

330
00:16:33,590 --> 00:16:30,899
there was any enantiomeric excess and

331
00:16:36,050 --> 00:16:33,600
they found that there was a preference

332
00:16:38,629 --> 00:16:36,060
for L forms in water solution okay so

333
00:16:44,170 --> 00:16:38,639
that was a well-characterized reaction

334
00:16:46,790 --> 00:16:44,180
that they were working with and we we

335
00:16:49,790 --> 00:16:46,800
got in collaboration with them and we

336
00:16:52,220 --> 00:16:49,800
asked them to to try to do the same

337
00:16:56,689 --> 00:16:52,230
reaction but in the presence of vesicles

338
00:16:58,120 --> 00:16:56,699

okay and for example this is a this is a

339
00:17:00,500 --> 00:16:58,130
graph that summarizes the type of

340
00:17:02,480 --> 00:17:00,510
results that we got in which you have

341
00:17:06,130 --> 00:17:02,490
decanoic acid here which is a fatty acid

342
00:17:09,470 --> 00:17:06,140
that self-assembles into one of those

343
00:17:10,669 --> 00:17:09,480
vesicles that were showing you similar

344
00:17:12,890 --> 00:17:10,679
vesicles that I was showing you in the

345
00:17:15,470 --> 00:17:12,900
previous crap okay so you see that as

346
00:17:18,490 --> 00:17:15,480
you increase the concentration of

347
00:17:20,900 --> 00:17:18,500
decanoic acid okay you get to the point

348
00:17:24,409 --> 00:17:20,910
to get to a point when you have a like a

349
00:17:27,439 --> 00:17:24,419
phase transition here a change in the

350
00:17:29,120 --> 00:17:27,449
behavior and this is actually the the

351
00:17:30,950 --> 00:17:29,130
point they create what is called the

352
00:17:32,539 --> 00:17:30,960
critical aggregation concentration is

353
00:17:35,419 --> 00:17:32,549
the point in the concentration of the

354
00:17:37,560 --> 00:17:35,429
fatty acid in which is saturates the

355
00:17:40,080 --> 00:17:37,570
water solution and

356
00:17:42,180 --> 00:17:40,090
starts forming those vesicles okay so

357
00:17:44,879 --> 00:17:42,190
something happens when when the vesicles

358
00:17:47,519 --> 00:17:44,889
are formed right below here you just

359
00:17:51,779 --> 00:17:47,529
have mono morning what the solution okay

360
00:17:55,820 --> 00:17:51,789
so it is an above here you have the

361
00:17:59,610 --> 00:17:55,830
vesicles okay so also we see that the

362
00:18:03,120 --> 00:17:59,620
astronomic ratio here goes down so the

363
00:18:05,659 --> 00:18:03,130

effects for el that we saw in water

364
00:18:09,539 --> 00:18:05,669
solution when the concentration of 0 are

365
00:18:13,409 --> 00:18:09,549
somehow counteracted okay and we have a

366
00:18:15,330 --> 00:18:13,419
more hetero keidel type of of result

367
00:18:18,389 --> 00:18:15,340
here but the important thing is that the

368
00:18:21,930 --> 00:18:18,399
yield of the reaction okay the yield of

369
00:18:24,180 --> 00:18:21,940
the reaction goes up and quite two or

370
00:18:27,389 --> 00:18:24,190
three fold okay so we see that in the

371
00:18:31,580 --> 00:18:27,399
presence of those vesicles somehow the

372
00:18:34,289 --> 00:18:31,590
formation of the vesicle helps in the

373
00:18:37,499 --> 00:18:34,299
reaction wheel of the formation of a d

374
00:18:41,249 --> 00:18:37,509
peptide dipeptide okay so we checked it

375
00:18:45,539 --> 00:18:41,259
and we saw that we did many different

376
00:18:48,090 --> 00:18:45,549
types of controls and instead of using

377
00:18:51,299 --> 00:18:48,100
photo and instead of using fatty acids

378
00:18:52,560 --> 00:18:51,309
we used phospholipids also negatively

379
00:18:55,399 --> 00:18:52,570
charged phospholipids we didn't get

380
00:18:57,869 --> 00:18:55,409
Reese also the result was specific for

381
00:19:02,220 --> 00:18:57,879
fatty acids okay so which are the

382
00:19:04,590 --> 00:19:02,230
precursors of phospholipids ok so we

383
00:19:07,619 --> 00:19:04,600
also did some experiments in an organic

384
00:19:13,830 --> 00:19:07,629
solution and we thought that the check

385
00:19:16,619 --> 00:19:13,840
in for different types of different

386
00:19:18,629 --> 00:19:16,629
types of systems here without the

387
00:19:20,639 --> 00:19:18,639
formation of the vesicles vesicle

388
00:19:21,980 --> 00:19:20,649

formation only takes place in water okay

389
00:19:24,240 --> 00:19:21,990
so when you are in organic solvents

390
00:19:27,629 --> 00:19:24,250
there are no vesicles but there is an

391
00:19:30,690 --> 00:19:27,639
effect okay and the effect based on

392
00:19:34,289 --> 00:19:30,700
these results is is related to the polar

393
00:19:36,299 --> 00:19:34,299
head more than the length of the fatty

394
00:19:41,310 --> 00:19:36,309
acid okay so there's something then

395
00:19:43,080 --> 00:19:41,320
happening that is somehow related to the

396
00:19:45,960 --> 00:19:43,090
formation of the vesicle but not only

397
00:19:48,930 --> 00:19:45,970
okay so that's why we call to the double

398
00:19:51,159 --> 00:19:48,940
role okay because it's important that

399
00:19:53,330 --> 00:19:51,169
they generate the kind of

400
00:19:55,520 --> 00:19:53,340
hydrophobic environment for the reaction

401
00:19:58,909 --> 00:19:55,530
to take place okay but at the same time

402
00:20:01,850 --> 00:19:58,919
there is catalysis happening okay so

403
00:20:03,530 --> 00:20:01,860
it's a in fact through some other

404
00:20:08,810 --> 00:20:03,540
experiments that I don't have time to go

405
00:20:12,350 --> 00:20:08,820
into details of them we showed that the

406
00:20:14,539 --> 00:20:12,360
is probably an acetate acid base

407
00:20:18,320 --> 00:20:14,549
catalysis happening at the at the

408
00:20:21,230 --> 00:20:18,330
interface there okay so first thing to

409
00:20:23,450 --> 00:20:21,240
provide an hydrophobic environment for

410
00:20:26,090 --> 00:20:23,460
the reaction to take place second as we

411
00:20:30,890 --> 00:20:26,100
bake analogies to actually help in the

412
00:20:34,780 --> 00:20:30,900
reaction okay so second I said first by

413
00:20:38,980 --> 00:20:34,790

the second second take-home message is

414
00:20:41,570 --> 00:20:38,990
worth trying with precursors okay

415
00:20:45,230 --> 00:20:41,580
instead of using phospholipids we used

416
00:20:47,930 --> 00:20:45,240
fatty acid and it worked better instead

417
00:20:49,640 --> 00:20:47,940
of using a protein we're using i don't i

418
00:20:52,700 --> 00:20:49,650
know it said the update I'm that

419
00:20:55,640 --> 00:20:52,710
dipeptide it's very humble and molecule

420
00:20:58,039 --> 00:20:55,650
okay but I think it's very important to

421
00:21:02,500 --> 00:20:58,049
continue working with really low

422
00:21:05,450 --> 00:21:02,510
complexity molecules if you work with

423
00:21:08,200 --> 00:21:05,460
with the polymers polymers I think are

424
00:21:11,000 --> 00:21:08,210
the result of the whole process of of

425
00:21:12,860 --> 00:21:11,010
origins of life or they biopolymers okay

426
00:21:15,289 --> 00:21:12,870
so it's important to work with

427
00:21:17,870 --> 00:21:15,299
biopolymers to know the properties of

428
00:21:20,450 --> 00:21:17,880
those molecules but i don't think i'll

429
00:21:22,760 --> 00:21:20,460
be a bit provocative here I don't think

430
00:21:25,390 --> 00:21:22,770
you are doing anything in terms of

431
00:21:28,970 --> 00:21:25,400
origins of life if you're working with

432
00:21:30,919 --> 00:21:28,980
the results what I think are the results

433
00:21:39,110 --> 00:21:30,929
molecules are the result of the process

434
00:21:46,190 --> 00:21:39,120
okay so enough I could go a bit further

435
00:21:48,650 --> 00:21:46,200
there but anyway so luckily the soft

436
00:21:54,130 --> 00:21:48,660
rock and other groups are working in

437
00:21:59,659 --> 00:21:58,130
this is really a new new new work that

438
00:22:02,330 --> 00:21:59,669

is very interesting and very related

439
00:22:04,130 --> 00:22:02,340
instead of having the oxide alone as we

440
00:22:08,690 --> 00:22:04,140
were doing they are doing the NC

441
00:22:12,950 --> 00:22:08,700
CA ok but way to activate the amino acid

442
00:22:14,720 --> 00:22:12,960
to get a dipeptide ok but maybe is

443
00:22:17,720 --> 00:22:14,730
probably because Jack Shaw start giving

444
00:22:20,540 --> 00:22:17,730
actually working hard enough on a

445
00:22:22,220 --> 00:22:20,550
definition of life that he's doing all

446
00:22:24,560 --> 00:22:22,230
these very interesting work and I don't

447
00:22:27,230 --> 00:22:24,570
know if you've noticed but in an all the

448
00:22:30,020 --> 00:22:27,240
abstract he needs to mention RNA RNA I

449
00:22:31,790 --> 00:22:30,030
mean even if he's doing very interesting

450
00:22:34,520 --> 00:22:31,800
stuff on other things that I haven't

451
00:22:37,520 --> 00:22:34,530
don't have anything to do with the RNA

452
00:22:40,040 --> 00:22:37,530
world okay but that's why sometimes it's

453
00:22:43,430 --> 00:22:40,050
good to do some conceptual clarification

454
00:22:45,650 --> 00:22:43,440
and maybe our obsessions at least we

455
00:22:52,010 --> 00:22:45,660
make them clear okay from the beginning

456
00:22:55,910 --> 00:22:52,020
ok ok so to start how much time do we

457
00:22:58,550 --> 00:22:55,920
have I'm still green okay I'm gonna so

458
00:23:00,320 --> 00:22:58,560
I'm still okay 10 minutes or so okay so

459
00:23:03,020 --> 00:23:00,330
i'm going to show you another instead of

460
00:23:04,790 --> 00:23:03,030
experimental part i'm going to do

461
00:23:07,370 --> 00:23:04,800
something that work that is

462
00:23:10,940 --> 00:23:07,380
computational okay but again in the same

463
00:23:12,890 --> 00:23:10,950

lines okay so the idea here is that we

464
00:23:16,100 --> 00:23:12,900
would have some sort of functional

465
00:23:18,560 --> 00:23:16,110
initial functional integration okay of

466
00:23:20,300 --> 00:23:18,570
precursor molecules in which we don't

467
00:23:22,100 --> 00:23:20,310
only take into account kinetic control

468
00:23:23,780 --> 00:23:22,110
but also station controller and if

469
00:23:27,080 --> 00:23:23,790
possible also thermodynamic viability

470
00:23:29,960 --> 00:23:27,090
vice is complicated okay there are some

471
00:23:32,840 --> 00:23:29,970
people this is a very interesting

472
00:23:34,810 --> 00:23:32,850
exception of synthetic biology i don't

473
00:23:38,180 --> 00:23:34,820
know if you've heard about the work of

474
00:23:41,960 --> 00:23:38,190
Nilla divided i am ok with very

475
00:23:44,840 --> 00:23:41,970
interesting work related precisely with

476
00:23:47,480 --> 00:23:44,850
this chemistry starting with precursors

477
00:23:52,780 --> 00:23:47,490
ok and trying to move from chemistry

478
00:24:01,510 --> 00:23:56,240
molecules we are not taking this step

479
00:24:04,490 --> 00:24:01,520
from chemistry right and here they also

480
00:24:08,560 --> 00:24:04,500
couple to some extent spatial control

481
00:24:11,360 --> 00:24:08,570
with kinetic control a catalyst and

482
00:24:14,720 --> 00:24:11,370
maybe so in order to move forward we

483
00:24:16,570 --> 00:24:14,730
also interesting to understand the

484
00:24:19,210 --> 00:24:16,580
systems we use

485
00:24:23,710 --> 00:24:19,220
platform that was developed by by my

486
00:24:25,539 --> 00:24:23,720
colleague saga valley and i won't go

487
00:24:26,980 --> 00:24:25,549
into the details of this but basically

488
00:24:29,289 --> 00:24:26,990

what we are doing is trying to

489
00:24:30,759 --> 00:24:29,299
understand what what are the

490
00:24:34,750 --> 00:24:30,769
implications are high in a reaction

491
00:24:37,630 --> 00:24:34,760
chemistry inside here that is actually

492
00:24:41,380 --> 00:24:37,640
compartmentalized okay and in what sense

493
00:24:44,710 --> 00:24:41,390
the compartment can be a nightmare for

494
00:24:47,380 --> 00:24:44,720
the chemistry or it could help lead the

495
00:24:50,370 --> 00:24:47,390
chemistry somewhere else I think closer

496
00:24:54,060 --> 00:24:50,380
and closer to biological systems okay so

497
00:24:56,529 --> 00:24:54,070
sometimes the compartment can can be

498
00:24:58,570 --> 00:24:56,539
counteractive in the sense of killing a

499
00:25:01,080 --> 00:24:58,580
chemistry that in water solution could

500
00:25:05,379 --> 00:25:01,090
be interesting but some of the times and

501
00:25:07,620 --> 00:25:05,389
dull a rather dull chemistry can become

502
00:25:10,389 --> 00:25:07,630
very interesting in a compartmentalized

503
00:25:11,799 --> 00:25:10,399
system if you take the dynamic

504
00:25:16,320 --> 00:25:11,809
properties of the compartment into

505
00:25:20,139 --> 00:25:16,330
account ok so imagine that you have a

506
00:25:22,480 --> 00:25:20,149
proto metabolic type of cycle this would

507
00:25:24,789 --> 00:25:22,490
be a la kaufman this could be a la Rosa

508
00:25:33,399 --> 00:25:24,799
okay this could represent a simplified

509
00:25:36,460 --> 00:25:33,409
version of a oh sorry this would be I

510
00:25:39,100 --> 00:25:36,470
know that is a bit too too much saying

511
00:25:40,990 --> 00:25:39,110
this but this could be an autotrophic

512
00:25:43,360 --> 00:25:41,000
type of simplified model of an

513
00:25:47,190 --> 00:25:43,370

autotrophic let up proto metabolism okay

514
00:25:50,139 --> 00:25:47,200
and this would be had a like

515
00:25:52,299 --> 00:25:50,149
heterotrophic type of of metabolism and

516
00:25:54,220 --> 00:25:52,309
we encapsulate them and we compare what

517
00:25:58,210 --> 00:25:54,230
happens to them in different conditions

518
00:26:01,019 --> 00:25:58,220
okay we do basically what we are going

519
00:26:05,200 --> 00:26:01,029
to be using here is the fact that this

520
00:26:08,440 --> 00:26:05,210
set of reactions can synthesize okay a

521
00:26:10,720 --> 00:26:08,450
lipid of alpha file molecule that is

522
00:26:15,009 --> 00:26:10,730
going to get integrated into the into

523
00:26:18,100 --> 00:26:15,019
the compartment okay and by changing so

524
00:26:20,799 --> 00:26:18,110
this reaction or this one here will

525
00:26:23,110 --> 00:26:20,809
create will synthesize and lipids I

526
00:26:25,029 --> 00:26:23,120
would go into the into the membrane here

527
00:26:27,669 --> 00:26:25,039
and the membrane will change its

528
00:26:29,789 --> 00:26:27,679
composition by changing its composition

529
00:26:32,700 --> 00:26:29,799
it will change

530
00:26:35,100 --> 00:26:32,710
its properties among other things is

531
00:26:37,859 --> 00:26:35,110
permeability okay and the idea here is

532
00:26:41,310 --> 00:26:37,869
that by checking experimentally the

533
00:26:47,299 --> 00:26:41,320
permeability of the system okay we see

534
00:26:49,109 --> 00:26:47,309
that mixed membranes made of mixed

535
00:26:51,570 --> 00:26:49,119
components okay had a higher

536
00:26:53,759 --> 00:26:51,580
permeability okay and in fact if you are

537
00:26:56,700 --> 00:26:53,769
in this case it was lauric acid with the

538
00:26:58,680 --> 00:26:56,710

dlp see that which were checking you see

539
00:27:01,889 --> 00:26:58,690
here that if you have a mixed system

540
00:27:04,919 --> 00:27:01,899
here the permeability has a non linear

541
00:27:06,779 --> 00:27:04,929
nonlinear behavior and it's in the

542
00:27:09,239 --> 00:27:06,789
middle somewhere in the middle here for

543
00:27:11,220 --> 00:27:09,249
mixed composition membranes where you

544
00:27:15,060 --> 00:27:11,230
get a higher permeability so the idea is

545
00:27:17,129 --> 00:27:15,070
that we usually make use of this we run

546
00:27:20,310 --> 00:27:17,139
the simulation so we saw that indeed

547
00:27:23,279 --> 00:27:20,320
when you start imagine that you start

548
00:27:25,349 --> 00:27:23,289
with a fatty acid vesicle the initial

549
00:27:28,320 --> 00:27:25,359
scaffolding okay and then there is a

550
00:27:31,259 --> 00:27:28,330
chemistry that is able to synthesize a

551
00:27:34,590 --> 00:27:31,269
slightly more complex alpha file that

552
00:27:37,499 --> 00:27:34,600
goes into the membrane that will change

553
00:27:39,539 --> 00:27:37,509
the properties of the membrane we

554
00:27:42,599 --> 00:27:39,549
increase this permeability and that will

555
00:27:45,779 --> 00:27:42,609
help for example these nutrients here

556
00:27:48,749 --> 00:27:45,789
get into the into the system and it will

557
00:27:51,029 --> 00:27:48,759
make the metabolism run faster okay and

558
00:27:53,820 --> 00:27:51,039
it will divide faster as well so that's

559
00:27:56,190 --> 00:27:53,830
what we see here in this graph here both

560
00:27:58,950 --> 00:27:56,200
for those the two types of metal proto

561
00:28:01,379 --> 00:27:58,960
metabolism you have an increase in the

562
00:28:06,539 --> 00:28:01,389
reaction rates here and a decrease in

563
00:28:08,039 --> 00:28:06,549

the reproduction time okay so a change

564
00:28:10,289 --> 00:28:08,049
like that could be a selective advantage

565
00:28:13,229 --> 00:28:10,299
in a scenario like this ok so there are

566
00:28:15,659 --> 00:28:13,239
many features that you can play with in

567
00:28:18,720 --> 00:28:15,669
a scenario like this in which you're

568
00:28:20,700 --> 00:28:18,730
being more dynamic and you are taking

569
00:28:25,080 --> 00:28:20,710
into account more the organization of

570
00:28:29,909 --> 00:28:25,090
the system so i'm orange already so

571
00:28:32,639 --> 00:28:29,919
let's try to start wrapping up so

572
00:28:36,899 --> 00:28:32,649
compartmentation does not make life easy

573
00:28:39,330 --> 00:28:36,909
and we have other other papers in which

574
00:28:41,310 --> 00:28:39,340
we see how compartmentation can be a

575
00:28:43,970 --> 00:28:41,320
pain okay

576
00:28:47,129 --> 00:28:43,980
life is complex so the sooner the better

577
00:28:51,720 --> 00:28:47,139
read already okay so let me reconcile

578
00:28:53,279 --> 00:28:51,730
with Jax before we I finish and say then

579
00:28:55,019 --> 00:28:53,289
I agree completely with this okay

580
00:28:57,120 --> 00:28:55,029
although proto cellular structure poses

581
00:28:59,180 --> 00:28:57,130
more problems initially it is actually

582
00:29:02,370 --> 00:28:59,190
simpler to solve these problems up front

583
00:29:04,350 --> 00:29:02,380
then leave them till later when they

584
00:29:06,629 --> 00:29:04,360
could become completely intractable

585
00:29:09,029 --> 00:29:06,639
that's that's what I think is happening

586
00:29:11,100 --> 00:29:09,039
okay you need to deal with compartments

587
00:29:15,799 --> 00:29:11,110
first because otherwise it's going to be

588
00:29:20,549 --> 00:29:15,809

impossible okay so I leave you with this

589
00:29:23,070 --> 00:29:20,559
nice bubbles in which we think that go

590
00:29:26,249 --> 00:29:23,080
together with I mean there is a lot of

591
00:29:27,779 --> 00:29:26,259
reflection and conceptual developments

592
00:29:29,460 --> 00:29:27,789
as well that go together with this we

593
00:29:31,409 --> 00:29:29,470
think we can start with functions we

594
00:29:33,629 --> 00:29:31,419
should go to regulation and we should go

595
00:29:38,249 --> 00:29:33,639
to information but this is too long a

596
00:29:39,539 --> 00:29:38,259
story for today we need to having we

597
00:29:41,940 --> 00:29:39,549
need to take into account the

598
00:29:44,580 --> 00:29:41,950
physiological type of cone and the

599
00:29:48,360 --> 00:29:44,590
evolutionary cone at the same time okay

600
00:29:49,860 --> 00:29:48,370
so this is the type of idea that when I

601
00:29:52,110 --> 00:29:49,870
say that the origins of I should be

602
00:29:55,049 --> 00:29:52,120
taken as a the process of development of

603
00:29:58,889 --> 00:29:55,059
protocell systems we start with very

604
00:30:01,680 --> 00:29:58,899
simple vesicles and these leads you to a

605
00:30:04,619 --> 00:30:01,690
different evolutionary Cohen here with

606
00:30:05,970 --> 00:30:04,629
and then as the as the vesicles change

607
00:30:09,570 --> 00:30:05,980
and they become more complex the

608
00:30:11,430 --> 00:30:09,580
evolutionary kong also changes okay so

609
00:30:16,470 --> 00:30:11,440
two dimensions have to be taken into

610
00:30:19,080 --> 00:30:16,480
account and to finish I so it's not just

611
00:30:22,440 --> 00:30:19,090
a question of having just the cell but

612
00:30:25,710 --> 00:30:22,450
what the pot the proto cellular and the

613
00:30:27,389 --> 00:30:25,720

individual idea but it's also have taken

614
00:30:30,419 --> 00:30:27,399
into account us as the different stages

615
00:30:32,119 --> 00:30:30,429
in origins of life unfold is there's

616
00:30:34,710 --> 00:30:32,129
going to be an unfolding of different

617
00:30:37,379 --> 00:30:34,720
say interactions at the collective level

618
00:30:41,909 --> 00:30:37,389
between those protocells ok so the

619
00:30:45,210 --> 00:30:41,919
scenario is complex ok and but I think

620
00:30:47,279 --> 00:30:45,220
we have to face it and I'm finishing now

621
00:30:51,080 --> 00:30:47,289
right with this code that i think is

622
00:30:54,000 --> 00:30:51,090
inspiring Alex works these days

623
00:30:55,049 --> 00:30:54,010
following below its of course sustain

624
00:30:57,149 --> 00:30:55,059
life is a property

625
00:30:59,399 --> 00:30:57,159
of an ecological system rather than a

626
00:31:01,200 --> 00:30:59,409
single organism or a species so thank

627
00:31:08,430 --> 00:31:01,210
you for your attention and I'm ready to

628
00:31:18,570 --> 00:31:08,440
take questions sorry okay so we have

629
00:31:27,549 --> 00:31:24,039
thanks cap out nice as ever and the how

630
00:31:29,620 --> 00:31:27,559
do you define them compartment because a

631
00:31:32,440 --> 00:31:29,630
lot of focus in a lot of people a little

632
00:31:35,890 --> 00:31:32,450
abscess on by layers with an a kiss in

633
00:31:37,210 --> 00:31:35,900
turn into internal the dieter in my

634
00:31:39,580 --> 00:31:37,220
experience certainly about the most

635
00:31:41,799 --> 00:31:39,590
difficult ones to handle it's much

636
00:31:45,100 --> 00:31:41,809
easier to do myself so coacervate is

637
00:31:48,340 --> 00:31:45,110
even simpler still at the is there in

638
00:31:51,430 --> 00:31:48,350

your view of progression from any of

639
00:31:54,400 --> 00:31:51,440
those structures towards the sort of

640
00:31:59,230 --> 00:31:54,410
cell like bilayer type assemblies

641
00:32:02,440 --> 00:31:59,240
receive these days in ok that's a very

642
00:32:05,140 --> 00:32:02,450
good question and I think that my cells

643
00:32:07,840 --> 00:32:05,150
and other types of supramolecular

644
00:32:10,330 --> 00:32:07,850
structures would be around okay so also

645
00:32:12,900 --> 00:32:10,340
for the dynamics of vesicles my toes are

646
00:32:16,240 --> 00:32:12,910
very important for different types of so

647
00:32:18,070 --> 00:32:16,250
colloidal systems are complicated and

648
00:32:21,909 --> 00:32:18,080
it's not just a single type of of

649
00:32:25,210 --> 00:32:21,919
supramolecular chemistry super molecular

650
00:32:28,120 --> 00:32:25,220
structure that I'm but the reason why I

651
00:32:31,890 --> 00:32:28,130
focus on on vesicles is because they

652
00:32:35,169 --> 00:32:31,900
give you a continuity line with biology

653
00:32:38,110 --> 00:32:35,179
that I mean because the thing is when

654
00:32:40,390 --> 00:32:38,120
you you have to have a one leg in

655
00:32:44,590 --> 00:32:40,400
chemistry and another leg in biology

656
00:32:49,180 --> 00:32:44,600
okay and I think that we need to you

657
00:32:51,159 --> 00:32:49,190
know bring the two together and whereas

658
00:32:52,690 --> 00:32:51,169
I think that there are many processes

659
00:32:55,560 --> 00:32:52,700
that could be very interesting to

660
00:32:58,780 --> 00:32:55,570
explore in a colloidal system that is

661
00:32:59,919 --> 00:32:58,790
very different from my cell okay there

662
00:33:02,680 --> 00:32:59,929
are some other things like we should

663
00:33:06,340 --> 00:33:02,690

explore that are closer to the cell okay

664
00:33:07,990 --> 00:33:06,350
and that's why I focus my research on on

665
00:33:10,000 --> 00:33:08,000
vesicles being aware that I don't know

666
00:33:12,669 --> 00:33:10,010
cooperates for example could be an

667
00:33:17,710 --> 00:33:12,679
option initially and some things could

668
00:33:21,880 --> 00:33:17,720
happen there but my let's say my

669
00:33:28,620 --> 00:33:21,890
research bias is more for trying to get

670
00:33:34,890 --> 00:33:29,880
so

671
00:33:38,630 --> 00:33:34,900
I agree that maybe vesicles could be

672
00:33:42,510 --> 00:33:38,640
initially but complicated to deal with

673
00:33:45,360 --> 00:33:42,520
nobody sells how to divide physicals

674
00:33:49,950 --> 00:33:45,370
adequately and you can enter via my cell

675
00:33:52,020 --> 00:33:49,960
and AG lab yeah but yeah I mean vesicles

676
00:33:54,420 --> 00:33:52,030
adequately okay the division of vesicles

677
00:34:00,110 --> 00:33:54,430
is complicated and and I can show

678
00:34:03,630 --> 00:34:00,120
ourselves do that ok so these paper here

679
00:34:06,720 --> 00:34:03,640
we are trying to deal with that ok how

680
00:34:08,880 --> 00:34:06,730
you could get the kinetic conditions so

681
00:34:10,889 --> 00:34:08,890
that you have a chemistry that is within

682
00:34:12,780 --> 00:34:10,899
the compartment that makes the

683
00:34:15,240 --> 00:34:12,790
compartment grow and what are the

684
00:34:19,560 --> 00:34:15,250
conditions for the compartment to get

685
00:34:23,310 --> 00:34:19,570
you know division so we I know it's hard

686
00:34:27,570 --> 00:34:23,320
but we are trying to get there and at

687
00:34:31,320 --> 00:34:27,580
some point we life got there which is

688
00:34:33,690 --> 00:34:31,330

the exact route to their I don't know

689
00:34:35,669 --> 00:34:33,700
you have an alternative may I discuss

690
00:34:38,490 --> 00:34:35,679
these things with people like Milan like

691
00:34:40,320 --> 00:34:38,500
working more classified type of all and

692
00:34:42,149 --> 00:34:40,330
how do you get from quality to the cell

693
00:34:48,090 --> 00:34:42,159
it's not it's not trivial at all either

694
00:34:50,490 --> 00:34:48,100
Oh for myself thanks hey Kaiba so why do

695
00:34:53,370 --> 00:34:50,500
you think it's easier to start with

696
00:34:57,600 --> 00:34:53,380
vesicles because I I never said easier

697
00:35:00,390 --> 00:34:57,610
you're easier earlier than later bunnies

698
00:35:02,580 --> 00:35:00,400
here I didn't say no okay so you think

699
00:35:04,050 --> 00:35:02,590
it's easier to have them later what are

700
00:35:05,910 --> 00:35:04,060
the benefits of them early I actually

701
00:35:10,110 --> 00:35:05,920
think it's much easier to get life

702
00:35:12,540 --> 00:35:10,120
started without vesicle without vesicles

703
00:35:14,250 --> 00:35:12,550
I think they came later also like you're

704
00:35:17,340 --> 00:35:14,260
referring to the opposite of this kind

705
00:35:20,610 --> 00:35:17,350
of modeling we also it's a it's a model

706
00:35:22,740 --> 00:35:20,620
about having some vesicle and then

707
00:35:24,570 --> 00:35:22,750
things happening no now psychical

708
00:35:26,460 --> 00:35:24,580
outside yeah well or some kind of

709
00:35:29,850 --> 00:35:26,470
compartment and all compartment no

710
00:35:31,620 --> 00:35:29,860
compartment only limited diffusion ok

711
00:35:33,330 --> 00:35:31,630
let me to diffusion yeah because I think

712
00:35:35,370 --> 00:35:33,340
you know what many things like I have

713
00:35:36,960 --> 00:35:35,380

any limiting diffusion whereas there are

714
00:35:38,730 --> 00:35:36,970
many things that can happen in limited

715
00:35:41,240 --> 00:35:38,740
diffusion and your surfaces and all

716
00:35:43,610 --> 00:35:41,250
these types of of chemistry's

717
00:35:45,680 --> 00:35:43,620
I agree right but I think that that

718
00:35:48,890 --> 00:35:45,690
solves a lot of the problems that Jack

719
00:35:51,230 --> 00:35:48,900
szostak is eliciting sells for early on

720
00:35:53,900 --> 00:35:51,240
I think it makes it a lot easier first

721
00:35:57,800 --> 00:35:53,910
to get life going if we don't have to

722
00:36:01,430 --> 00:35:57,810
compartmentalize it could be it depends

723
00:36:04,450 --> 00:36:01,440
on your I gotta go back to my site it

724
00:36:09,350 --> 00:36:04,460
depends on whether you want to get to

725
00:36:11,810 --> 00:36:09,360
let me check easy one if your objective

726
00:36:15,220 --> 00:36:11,820
is to get to a population of genetically

727
00:36:17,810 --> 00:36:15,230
instructed cellulite metabolisms look at

728
00:36:19,310 --> 00:36:17,820
you are really because that's something

729
00:36:21,920 --> 00:36:19,320
that I want to discuss with jack and

730
00:36:24,410 --> 00:36:21,930
jack keep speaking about cellular life

731
00:36:27,410 --> 00:36:24,420
cellular life vanilla life we have to a

732
00:36:30,290 --> 00:36:27,420
life and cellular service mean it's a

733
00:36:32,330 --> 00:36:30,300
redundancy okay well i don't know but

734
00:36:33,920 --> 00:36:32,340
even linear system depends what I'm

735
00:36:37,190 --> 00:36:33,930
saying is for me it's a redundancy for

736
00:36:40,040 --> 00:36:37,200
some people if you think that life is

737
00:36:43,310 --> 00:36:40,050
something different and life could

738
00:36:45,770 --> 00:36:43,320

happen without cells and like would be

739
00:36:47,780 --> 00:36:45,780
just a replicating a molecule or

740
00:36:49,760 --> 00:36:47,790
something like that then maybe you're

741
00:36:51,560 --> 00:36:49,770
right but well I actually think Luke I

742
00:36:54,530 --> 00:36:51,570
didn't have compartmentalization yet

743
00:36:56,990 --> 00:36:54,540
okay lately the universality that gives

744
00:36:58,520 --> 00:36:57,000
us Lucas has to do with nucleic acids as

745
00:37:00,020 --> 00:36:58,530
it is protein it does not need to be

746
00:37:01,550 --> 00:37:00,030
with memory to be seen places in the

747
00:37:03,380 --> 00:37:01,560
same in the same way as you saying that

748
00:37:09,470 --> 00:37:03,390
for look at ATP synthesis were there

749
00:37:12,530 --> 00:37:09,480
Aluko ATP synthesis no well okay we can

750
00:37:21,560 --> 00:37:12,540
discuss that Luca had compartments and

751
00:37:25,300 --> 00:37:21,570
quite sure about that yes thank you very

752
00:37:29,120 --> 00:37:25,310
much I enjoyed very much but I couldn't

753
00:37:34,060 --> 00:37:29,130
understand that scenario or you're in a

754
00:37:38,890 --> 00:37:34,070
story you should therefore steps of

755
00:37:45,290 --> 00:37:38,900
scenario from the profile to depict off

756
00:37:47,690 --> 00:37:45,300
next one yeah that's why

757
00:37:50,840 --> 00:37:47,700
so it is work in progress and we are

758
00:37:53,030 --> 00:37:50,850
yeah but they dock ritual I want to ask

759
00:37:56,660 --> 00:37:53,040
you to watch you on stage or your

760
00:37:59,750 --> 00:37:56,670
research my research is down here in

761
00:38:02,120 --> 00:37:59,760
this one it's down here okay okay so but

762
00:38:04,370 --> 00:38:02,130
I'm very aware of all the difficulties

763
00:38:07,730 --> 00:38:04,380

that come later right I couldn't

764
00:38:11,630 --> 00:38:07,740
understand how your differentiate the

765
00:38:14,750 --> 00:38:11,640
first category of a from the other

766
00:38:18,620 --> 00:38:14,760
researchers work what with the other

767
00:38:21,350 --> 00:38:18,630
research right okay so basically what we

768
00:38:23,900 --> 00:38:21,360
are taking here is a really a bottom-up

769
00:38:26,750 --> 00:38:23,910
approach okay in which you start with

770
00:38:31,190 --> 00:38:26,760
building blocks that are probiotic Lee

771
00:38:33,410 --> 00:38:31,200
possible alphas files amino acids very

772
00:38:35,150 --> 00:38:33,420
simple things and you will start from

773
00:38:36,440 --> 00:38:35,160
the bottom up and you start with this

774
00:38:38,810 --> 00:38:36,450
type of system in which you have

775
00:38:40,790 --> 00:38:38,820
vesicles under what I call here

776
00:38:43,250 --> 00:38:40,800
environmental control in some sense okay

777
00:38:48,200 --> 00:38:43,260
there you have the scaffolding and then

778
00:38:49,610 --> 00:38:48,210
right and then you couple these with the

779
00:38:51,440 --> 00:38:49,620
chemistry this is the second example

780
00:38:55,930 --> 00:38:51,450
that I was talking about when you have a

781
00:38:59,090 --> 00:38:55,940
chemistry that is coupled with vertical

782
00:39:01,640 --> 00:38:59,100
dynamics okay and there is a different

783
00:39:05,870 --> 00:39:01,650
stage and then you can have taught

784
00:39:08,870 --> 00:39:05,880
ourselves with some kind of more

785
00:39:11,930 --> 00:39:08,880
elaborated physiology here where you

786
00:39:13,790 --> 00:39:11,940
have not only for example template

787
00:39:15,860 --> 00:39:13,800
mechanisms or other types of Canada

788
00:39:18,320 --> 00:39:15,870

telemetric mechanisms but you also have

789
00:39:21,920 --> 00:39:18,330
regulation relative so the more complex

790
00:39:24,140 --> 00:39:21,930
the unit is here then I don't know

791
00:39:26,810 --> 00:39:24,150
different types of evolutionary columns

792
00:39:29,540 --> 00:39:26,820
appear this is work in progress i'm not

793
00:39:32,990 --> 00:39:29,550
i'm not suggesting that i have any

794
00:39:34,310 --> 00:39:33,000
results related to this okay but and

795
00:39:37,580 --> 00:39:34,320
then when you have a phenotype genotype

796
00:39:41,300 --> 00:39:37,590
decoupling which would be sorry please

797
00:39:43,130 --> 00:39:41,310
bit here at the end okay you will have a

798
00:39:45,290 --> 00:39:43,140
different type of evolution this would

799
00:39:46,970 --> 00:39:45,300
be open-ended evolution whereas these

800
00:39:50,600 --> 00:39:46,980
types of evolution that you have here

801
00:39:53,300 --> 00:39:50,610
are not open ended yet okay so this kind

802
00:39:55,400 --> 00:39:53,310
of scheme ok so you we need to actually

803
00:39:58,940 --> 00:39:55,410
characterize this evolutionary cones

804
00:40:02,870 --> 00:39:58,950
here where where you don't have by all

805
00:40:12,560 --> 00:40:02,880
logical evolution as such I hope you

806
00:40:14,420 --> 00:40:12,570
could take it kept good luck yes kappa

807
00:40:16,490 --> 00:40:14,430
you said you need a leg in biology or

808
00:40:19,359 --> 00:40:16,500
leg in chemistry but don't you need a

809
00:40:23,240 --> 00:40:19,369
leg in theology and do you try some of

810
00:40:27,770 --> 00:40:23,250
experiments in a with ion from minerals

811
00:40:30,250 --> 00:40:27,780
oh absolutely I agree that have to do a

812
00:40:36,050 --> 00:40:30,260
leg so for whatever I want it has to be

813
00:40:38,300 --> 00:40:36,060

geology as well so again I think it's

814
00:40:41,000 --> 00:40:38,310
really important to whenever you have a

815
00:40:43,010 --> 00:40:41,010
system to actually put it in the context

816
00:40:48,620 --> 00:40:43,020
of geochemical context where it makes

817
00:40:49,730 --> 00:40:48,630
sense okay but again my bias is a bit to

818
00:40:51,560 --> 00:40:49,740
try to understand biological

819
00:40:54,950 --> 00:40:51,570
organization and how that biological

820
00:40:58,880 --> 00:40:54,960
organization started and I think there

821
00:41:03,020 --> 00:40:58,890
are many things that play functional

822
00:41:05,690 --> 00:41:03,030
roles that come from geo okay but I'm

823
00:41:08,030 --> 00:41:05,700
I'm kind of interested in how those

824
00:41:09,890 --> 00:41:08,040
things got integrated into these other

825
00:41:14,470 --> 00:41:09,900
dynamics that is a biological dynamics

826
00:41:17,870 --> 00:41:14,480
in but it's not a satisfactory answer

827
00:41:19,520 --> 00:41:17,880
i'm sorry it's just a question of focus

828
00:41:21,050 --> 00:41:19,530
I act but I agree completely that it

829
00:41:23,990 --> 00:41:21,060
should be one leg should be also in

830
00:41:39,170 --> 00:41:27,590
[Applause]